Fabrication and characterization of embedded defects in silicon colloidal photonic crystals

P. V. Braun, F. Garcia-Santamaria, S. A. Rinne, and E. C. Nelson
Department of Materials Science and Engineering, Beckman Institute, and Frederick Seitz Materials Research Laboratory, 1304 W. Green St., Urbana, IL, USA

The holographic and self-assembly based fabrication of three-dimensional (3D) colloidal photonic crystals with the potential to show a complete photonic bandgap at optical wavelengths has been demonstrated. However for many applications, simple periodic structures are not sufficient. It remains unclear how to add function to such structures in an efficient fashion, be this introduction of aperiodic features, functional materials, or active components. Over the last few years, we demonstrated the use of two-photon polymerization to embed 3D features within self-assembled photonic crystals [1-3], however these preliminary structures were not designed to be optically active. We have dramatically improved the quality of the embedded features, and will also provide evidence that suggests successful waveguiding through straight and double-bend defects embedded within a 3D silicon-air inverse opal. The optical behavior of other features embedded in a self-assembled photonic band gap material, including planar defects and optical cavities will also be discussed.

[1] W. M. Lee, S. A. Pruzinsky, and P. V. Braun, *Adv. Mater.,* **14**, 271 (2002).
[2]. S. A. Pruzinsky, and P. V. Braun, *Adv. Funct. Mater.*, **15**, 1995 (2005).
[3]. P. V. Braun, S. A. Rinne, and F. García-Santamaría, *Adv. Mater.*, **18**, 2665 (2006).